



U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

3.5.1.6 AIRCRAFT HAZARDS

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of man-made site hazards.

Secondary - None

I. AREAS OF REVIEW

The purpose of the review is to assure that the risks from aircraft hazards are sufficiently low. Probabilistic considerations may be used to demonstrate that aircraft hazards need not be a design-basis concern. Otherwise, design-basis aircraft identification is made and the applicant's plant design is evaluated to assure that it is protected against the potential effects of aircraft impacts and fires. This SRP section applies to the review of a construction permit (CP) or an operating license (OL) application submitted pursuant to 10 CFR Part 50, or an early site permit (ESP), design certification (DC), or combined license (COL) application submitted pursuant to 10 CFR Part 52.

The specific areas of review are as follows:

1. The staff reviews the applicant's assessment of aircraft hazards to the plant to determine whether or not they should be incorporated into the plant design basis.

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USNRC STANDARD REVIEW PLAN

This Standard Review Plan, NUREG-0800, has been prepared to establish criteria that the U.S. Nuclear Regulatory Commission staff responsible for the review of applications to construct and operate nuclear power plants intends to use in evaluating whether an applicant/licensee meets the NRC's regulations. The Standard Review Plan is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide an acceptable method of complying with the NRC regulations.

The standard review plan sections are numbered in accordance with corresponding sections in Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)." Not all sections of Regulatory Guide 1.70 have a corresponding review plan section. The SRP sections applicable to a combined license application for a new light-water reactor (LWR) are based on Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)."

These documents are made available to the public as part of the NRC's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Individual sections of NUREG-0800 will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience. Comments may be submitted electronically by email to NRR_SRP@nrc.gov.

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The specific acceptance criteria and review procedures are contained in the referenced SRP sections.

II. ACCEPTANCE CRITERIA

Requirements

Acceptance criteria are based on meeting the relevant requirements of the following Commission regulations:

1. 10 CFR Part 100, 10 CFR 100.10, 10 CFR 100.20, 10 CFR 100.21, and 10 CFR 52.79, as they relate to the factors to be considered in the evaluation of sites. These regulations require that reactors reflect through their design, construction, and operation an extremely low probability for accidents that could result in the release of significant quantities of radioactive fission products. In addition, 10 CFR Part 100, 10 CFR 100.10, and 10 CFR 100.20 require that the site location, in conjunction with other considerations, ensure a low risk of public exposure.
2. 10 CFR 50, Appendix A, General Design Criterion (GDC) 3 requires that SSCs important to safety be appropriately protected against the effects of fires.
3. GDC 4 requires that SSCs important to safety be appropriately protected against the effects of missiles that may result from events and conditions outside the nuclear power unit.
4. For ESP applications (as they relate to the factors to be considered in the evaluation of sites), the acceptance criteria are based on meeting the relevant requirements of 10 CFR 52.17, 10 CFR 100.20, and 10 CFR 100.21. These requirements stipulate that the individual and societal risk of potential plant accidents must be low.
5. 10 CFR 52.47(b)(1), which requires that a DC application contain the proposed inspections, tests, analyses, and acceptance criteria (ITAAC) that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations;
6. 10 CFR 52.80(a), which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the combined license, the provisions of the Atomic Energy Act, and the NRC's regulations.

The plant meets the relevant requirements of GDC 3 and GDC 4, and is considered appropriately protected against design-basis aircraft impacts and fires, if the SSCs important to safety are capable of withstanding the effects of the postulated aircraft impacts and fires without loss of safe-shutdown capability and without causing a release of radioactivity that could exceed the 10 CFR Part 100 dose guidelines.

Regulatory Guide (RG) 1.117 provides acceptable methods for determining those SSCs that should be protected. The selection of SSCs to be protected is based upon not allowing offsite exposures to exceed an appropriate fraction of the offsite dose guidelines of 10 CFR Part 100. Basing the limits upon an appropriate "fraction" ensures protection for those events that are not as severe as the design-basis event but have a higher probability of occurrence. Protecting those SSCs important to safety from the effects of externally generated missiles due to aircraft hazards prevents failure of those systems required for safe shutdown and prevents the release of radioactivity with the potential for causing exposures in excess of the 10 CFR Part 100 guidelines.

The expected rate of exposure identified in 10 CFR 50.34(a)(1) dose guideline as it relates to the requirements identified in 10 CFR 100.20(b) should be about an order of magnitude of 10^{-6} per year. If it can be shown with rigorous analysis, using realistic assumptions and reasonable arguments that the estimated probability could be lower, then, in accordance with the SRP Section 2.2.3, it is acceptable.

Technical Rationale

The technical rationale for application of these acceptance criteria to the areas of review addressed by this SRP section is discussed in the following paragraphs:

1. Aircraft crash hazards that have the potential for causing onsite accidents leading to the release of significant quantities of radioactive fission products, and thus pose an undue risk of public exposure, should have a sufficiently low probability of occurrence and be within the requirements of the low probability of occurrence criteria of 10 CFR 100.10, and 10 CFR 100.20.
2. GDC 3 establishes requirements regarding minimizing the probability and effect of fires and explosions on SSCs important to safety. Aircraft hazards include the potential through an aircraft impact for fires and explosions that could effect SSCs important to safety. RG 1.117 describes an acceptable method for determining which SSCs should be protected. Protecting those SSCs that are important to safety from the effects of aircraft hazards ensures the capability to shutdown the reactor and maintain it in a shutdown condition and the capability to prevent the release of radioactivity with the potential for causing exposures in excess of the 10 CFR Part 100 guidelines.
3. GDC 4 establishes requirements regarding the ability of SSCs important to safety to be protected from dynamic effects, including the effects of missiles that may result from events and conditions outside the nuclear plant. Aircraft hazards are events outside of the nuclear plant that could have the potential for missile generation. The initiation of an externally generated missile due to aircraft impacts is a dynamic effect and the effect of those missiles on SSCs important to safety must be evaluated.

This gives a conservative upper bound on aircraft impact probability if care is taken in using values for the individual factors that are meaningful and conservative. For commercial aircraft a value of $C = 4 \times 10^{-10}$ (Ref. 11) per aircraft mile has been used. For heavily traveled corridors (greater than 100 flights per day), a more detailed analysis may be required to obtain a proper value for this factor.

3. Civilian and Military Airports and Heli-Ports. The probability of an aircraft crashing into the site should be estimated for cases in which one or more of the conditions in item II.1 of the acceptance criteria are not met. The probability per year of an aircraft crashing into the site for these cases (P_A) may be calculated by using the following expression:

$$P_A = \sum_{i=1}^L \sum_{j=1}^M C_j N_{ij} A_j$$

where:

- M = number of different types of aircraft using the airport
- L = number of flight trajectories affecting the site
- C_j = probability per square mile of a crash per aircraft movement, for the jth aircraft
- N_{ij} = number (per year) of movements by the jth aircraft along the ith flight path
- A_j = effective plant area (in square miles) for the jth aircraft

The manner of interpreting the individual factors in the above equation may vary on a case-by-case basis because of the specific conditions of each case or because of changes in aircraft accident statistics.

Values for C_j currently being used are taken from the data summarized in the following table:

Where estimated risks from military aircraft activity are found to be unacceptably high, suitable airspace or airway relocation should be implemented. Past experience has been that military authorities have been responsive to modification of military operations and relocation of training routes in close proximity to nuclear power plant sites.

5. Holding Patterns. Holding patterns are racetrack-shaped courses at specified altitudes, associated with one or more radio-navigational facilities, where aircraft can "circle" while awaiting clearance to execute an approach to a landing at an airport or to continue along an airway. Holding patterns that are sufficiently distant from the plant need not be considered (see Subsection II above). Otherwise, traffic in the holding pattern should be converted into equivalent aircraft passages taking into account the characteristics, including orientation with respect to the plant, of the holding pattern. The information in item III.2 above should be used in this evaluation.
6. The total aircraft hazard probability at the site equals the sum of the individual probabilities obtained in the preceding steps.
7. The effective plant areas used in the calculations should include the following:
 - A. A shadow area of the plant elevation upon the horizontal plane based on the assumed crash angle for the different kinds of aircraft and failure modes.
 - B. A skid area around the plant as determined by the characteristics of the aircraft under consideration. Artificial berms or any other manmade and natural barriers should be taken into account in calculating this area.
 - C. The areas of those safety-related SSCs that are susceptible to impact or fire damage as a result of aircraft crashes.
8. Review Procedures Specific to 10 CFR Part 52 Application Type
 - A. Early Site Permit Reviews

Subpart A to 10 CFR Part 52 specifies the requirements and procedures applicable to the Commission's review of an ESP application for approval of a proposed site. Information required in an ESP application includes a description of the site characteristics and design parameters of the proposed site. The scope and level of detail of review of data parallel that used for a CP review.

In the absence of certain circumstances, such as a compliance or adequate protection issue, 10 CFR 52.39 precludes the staff from imposing new site characteristics, design parameters, or terms and conditions on the early site permit at the COL stage. Accordingly, the reviewer should ensure that all physical attributes of the site that could affect the design basis of SSCs important to safety are reflected in the site characteristics, design parameters, or terms and conditions of the early site permit.

responsible for identifying changes of which it is aware, that would satisfy the criteria specified in 10 CFR 52.39. Information provided by the applicant in accordance with 10 CFR 52.6(b) will be addressed by the staff during the review of a COL application referencing an ESP or a DC.

For a COL application referencing either an ESP or DC or both, the staff should review the corresponding sections of the ESP and DC FSER to ensure that any early site permit conditions, restrictions to the DC, or COL action items identified in the FSERs are appropriately handled in the COL application.

IV. EVALUATION FINDINGS

The review should document the staff's evaluation of site characteristics against the relevant regulatory criteria. The evaluation should support the staff's conclusions as to whether the regulations are met. The reviewer should state what was done to evaluate the applicant's safety analysis report. The staff's evaluation may include verification that the applicant followed applicable regulatory guidance, performance of independent calculations, and/or validation of appropriate assumptions. The reviewer may state that certain information provided by the applicant was not considered essential to the staff's review and was not reviewed by the staff. While the reviewer may summarize or quote the information offered by the applicant in support of its application, the reviewer should clearly articulate the bases for the staff's conclusions.

The reviewer verifies that the applicant has provided sufficient information and that the review and calculations (if applicable) support conclusions of the following type to be included in the staff's safety evaluation report. The reviewer also states the bases for those conclusions.

Specifically, the reviewer drafts an introductory paragraph for the evaluation findings describing the procedure used in evaluating the aircraft hazards with respect to the safety-related SSCs. The reviewer verifies that the site location is acceptable and meets the requirements of 10 CFR Part 100, 10 CFR 100.10, or 10 CFR 100.20, as appropriate and is in accordance with 10 CFR 50.34 for a CP and an OL and 10 CFR 52.17 for an ESP and 52.79 for a COL.

The basis for the above findings may be strictly in terms of the probabilities associated with potential aircraft crashes on site. If the aircraft crash statistics applicable to the onsite facilities are such that SRP Section 2.2.3 criteria are met without explicit consideration of plant design features, then conclusions of the following type should be included in the staff's safety evaluation report:

The staff concludes that the operation of the _____ plant in the vicinity of _____ does not present an undue risk to the health and safety of the public and meets the relevant requirements of 10 CFR Part 100 and 10 CFR 100.10 (or 10 CFR 100.20, as appropriate). This conclusion is based on the staff's independent verification of the applicant's assessment of aircraft hazards at the site that resulted in a probability less than about 10^{-7} per year for an accident having radiological consequences worse than the exposure guidelines of 10 CFR Part 100.

VI. REFERENCES

1. 10 CFR Part 100, "Reactor Site Criteria," Subpart A, "Evaluation Factors for Stationary Power Reactor Site Applications Before January 10, 1997 and for Testing Reactors," Section 100.10, "Factors To Be Considered When Evaluating Sites."
2. 10 CFR Part 100, "Reactor Site Criteria," Subpart B, "Evaluation Factors for Stationary Power Reactor Site Applications on or After January 10, 1997," Section 100.20, "Factors To Be Considered When Evaluating Sites."
3. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants," Subpart A, "Early Site Permits," Section 52.17, "Contents of Applications, Technical Information."
4. 10 CFR Part 100, "Reactor Site Criteria," Subpart B, "Evaluation Factors for Stationary Power Reactor Site Applications on or After January 10, 1997," Section 100.21, "Non-Seismic Siting Criteria."
5. 10 CFR 50.34(a)(1)(ii) "Contents of Application, Technical Information."
6. 10 CFR 52.47(a) "Contents of Application, Technical Information."
7. 10 CFR 52.79(a)(1)(vi) "Contents of Application, Technical Information in Final Safety Analysis Report."
8. Regulatory Guide 1.117, "Tornado Design Classification."

PAPERWORK REDUCTION ACT STATEMENT

The information collections contained in the Standard Review Plan are covered by the requirements of 10 CFR Part 50 and 10 CFR Part 52, and were approved by the Office of Management and Budget, approval number 3150-0011 and 3150-0151.

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